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Volume Author/Editor: Murray F. Foss, Gary Fromm, and Irving Rottenberg

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Chapter Author: Murray F. Foss, Gary Fromm, Irving Rottenberg

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3. BUREAU OF CENSUS ESTIMATES OF BOOK VALUES OF INVENTORIES

The Bureau of the Census collects monthly data on book values of inventories in manufacturing and wholesale and retail trade. At the end of 1976 these three groups held 86 percent of the nation's total business inventories, or 91 percent of the nation's nonfarm business inventories. These data, which are published in varying degrees of industry detail, are closely watched by business executives and economists, particularly in relation to sales. Book value figures are the starting point for Bureau of Economic Analysis estimates of quarterly inventory change in the GNP, and, more recently, for estimates of constant dollar inventories and inventory changes within industries.

Typically, the surveys by which monthly inventory statistics are collected are benchmarked to more complete data, but there is no uniformity in benchmarking sources or procedures. Special annual surveys are conducted to provide bases for annual revisions in estimates of manufacturing and retail trade inventories. Every five years a comprehensive census is taken; the most recent was for 1977. In census years, reports from all establishments (plants, stores, etc.—essentially each separate location) are collected on a nationwide basis in manufacturing, wholesale trade, retail trade, and certain other industrial sectors. Although a wide range of data, including figures on book values of inventories for wholesale trade and manufacturing, are obtained from quinquennial censuses, inventory statistics for retail trade are not requested.

Data collected from respondents to monthly and annual surveys and quinquennial censuses are grouped by industry divisions and detailed industries according to the Standard Industrial Classification (SIC) manual. Issued by the Office of Management and Budget (OMB), the SIC is a classification of establishments for use by Government agencies and others. It is revised occasionally, usually in years a census is taken. Generally, the present pattern of the SIC was set in the 1950's, although subsequent modifications in the classification structure have been made. OMB also issues an Enterprise Classification System directed toward statistical problems arising from the vertical and horizontal integration of firms. The latter classification system has received relatively little attention outside the Government. It is consistent with the establishment coding structure to the extent possible, but mixtures of industrial activity in multiestablishment enterprises, conglomerates and the like are also taken into account.

The Census Bureau collects data from many kinds of reporting units. In addition to establishments (in which case each lo-

cation or place of business is a separate reporting unit), four other types of reporting units are noted in the manufacturing, wholesale and retail trade sections of this chapter:

Employer Identification Unit (EI) unit. This is a legal entity, essentially a corporation, partnership or proprietorship, responsible for social security and unemployment insurance taxes. When an employer has one establishment, the E.I. unit is coterminous with that establishment.

Enterprise (company, firm). This unit encompasses all activities under a common ownership. It may consist of one establishment and one EI unit. It may be many establishments coterminous with one EI unit or it may consist of several EI's. The latter is typical of large firms in which there is a parent corporation, several subsidiary corporations (each a legal entity), and many establishments.

Central Administrative Offices and Auxiliaries (CAO's). When establishment data are collected, as in a quinquennial census, a distinction is made between operating establishments and various types of support establishments. The latter are locations not directly involved in the main business of firms but are supportive or ancillary to the operating establishments. They include separate executive offices, warehouses, research centers, credit offices, repair shops, etc.

Division. This is a company component conducting a unique activity for which a separate reporting unit is desired. Separate divisions may be recognized within firms for management purposes or they may be designated as separate reporting units to fulfill Census requests.

This chapter contains a discussion of definitions, reporting units, sampling methods and other procedures pertinent to the Census Bureau's estimation of book values of inventories and some problems in compilation. It is divided into three main sections: manufacturing, wholesale trade, and retail trade statistics. Valuation problems of the type noted in chapter 2 are either omitted or very briefly discussed because they are detailed in later chapters.

MANUFACTURING INDUSTRIES

Manufacturers' stocks are the most significant part of non-farm inventories, accounting for approximately half of nonfarm totals in recent years and a higher proportion of nonfarm changes in inventories. The first monthly inventory statistics collected by the Federal Government were for manufacturing. Although statistics on manufacturers' inventories have the longest history, they also pose some of the most difficult problems in inventory accounting, for example, the valuation of partly finished goods, treatment of manufacturing overhead, and extensive use of LIFO. In this section some problems associated with gathering manufacturing inventory data are discussed, such as sampling, benchmarking, and certain problems of estimation. Others, however, are of such complexity they are examined in separate chapters: LIFO inventory valuation in chapters 6 and 7, reporting units in chapter 9, overhead costs in chapter 10, and long-term contracts in chapter 11.

Census inventory statistics for manufacturing come from two main sources: the M3 survey and the annual survey of manufactures (ASM). The monthly survey conducted with Census form M3 (Manufacturers' Shipments, Inventories, and Orders) has about 4,500 reporting units, of which about 3,500 report in a typical month. The reporting units are companies, except for approximately 450 firms from whom about 1,000 divisional reports are obtained. At present, the M3 is not a probability sample but is essentially a survey of large firms; none have less than 100 employees and most are considerably larger. The survey is voluntary but special attempts are made to get reports from all very large firms.

Annual data are obtained in the quinquennial census of manufactures and in a large sample survey of manufacturers (the ASM) taken in each of the intervening four years. The reporting unit in both of these instances is the establishment (plant). The annual survey of manufactures is a probability sample in which more than 70,000 establishments, owned by about 30,000 enterprises, report on a mandatory basis.

History of the M3 Survey

The monthly survey of manufacturing firms (M3) reporting sales, orders, and inventory data was started in the 1940's in the Department of Commerce by what was formerly the Office of Business Economics (OBE), now the Bureau of Economic Analysis (BEA). In the beginning about 1,600 large firms responded each month. Each firm submitted a single report that was classified in one of a group of industries on the basis of the principal type of goods sold. Data from the monthly survey were benchmarked to annual statistics published by the Internal Revenue Service with a lag of about two and one-half years.

Large firms account for a much greater proportion of output or assets in manufacturing than in wholesale or retail trade. According to Internal Revenue Service balance sheet data for 1971, 335 firms with assets over \$250 million accounted for 56 percent of manufacturers' inventories; the 1,000 largest manufacturing firms accounted for more than 70 percent. By comparison, in wholesale trade, firms with assets above \$250

million numbered only 22 and accounted for only 6 percent of inventories. In retail, there were only 33 firms in 1971 with assets over \$250 million accounting for about 17 percent of total retail inventories. This dominance by large firms in manufacturing led initially to a different approach by OBE in the collection of inventory and related data. Essentially, OBE concentrated on large firms because of the high cost of conducting a probability sample.

Following recommendations in a report on inventory statistics, published in 1955 and sponsored by the Federal Reserve Board,¹ survey operations were transferred to the Bureau of the Census. After Census assumed full responsibility in 1962-63, changes were instituted in reporting procedures. An attempt was made to utilize a scientifically selected probability sample of small companies in the survey. These small companies, weighted by size, increased the M3 panel to nearly twice its present coverage. But, noise caused by intermittent and erratic reporting by small companies, whose data were multiplied by large weights, and the high cost incurred in collecting information from many small respondents, led to the elimination from the survey of both the small respondents and extra weights for the middle-sized ones. The "chunk-type" survey, now used, evolved as the next best alternative.

A number of other recommendations from the Federal Reserve Consultant Committees on Economic Statistics were put into effect: the number of firms in the sample was doubled and divisional reporting was introduced, although initially on a modest scale.

Method of Estimation and Benchmarking

Monthly data are collected by use of a computer-prepared shuttle form. A respondent is mailed a form that contains data reported by the firm for the two prior months. The respondent may revise the prior-months data.

Estimates are derived essentially by a link-relative ratio procedure in which the prior-month estimate for a detailed industry is multiplied by the ratio of change for firms reporting both the prior and current month. The ratio of change for reporting units for adjacent months, say, March and April, is used to estimate a value for the current month, April, by calculating the ratio of April to March for all reporting cases and multiplying the March total by the ratio. The operation is performed at a disaggregated level for more than 75 industries. Results for the 75 industries are then aggregated to arrive at total manufacturing, durable and nondurable subtotals, and various supplementary market categories.

For inventories, a three-way breakdown by stage of fabrication is also requested of each responding unit: (1) materials and supplies, (2) work in process, and (3) finished goods. Since response rates by stage of fabrication are less than for total inventories, a slightly different estimating procedure is employed. The percentage change in inventory is calculated for each of the

¹See *Hearings on Reports of Federal Reserve Consultant Committees on Economic Statistics*, before the Subcommittee on Economic Statistics of the Joint Economic Committee, 84th Congress, 1st Session (1955) p. 420 ff.

three stages of fabrication in each of twenty 2-digit industries of the SIC, and is applied to the prior month estimate at that level of aggregation. Total inventories for the 75 industry groups are combined into 20 industries. For each of the 20 industries this inventory total is controlling because it is based upon more comprehensive reporting. At the 20-industry level of detail any differences between the estimated total and the sum of the three stages of fabrication are resolved by a proportionate adjustment of each of the stages.

One difficulty with the link-relative process just described is that statistics from larger firms dominate the estimates. Small firms are not represented in the sample. Furthermore, each of the 75 industry groups is estimated as a unit with no stratification by size of firm within each industry. "Blow-up," or weighting factors for data from individual firms are not applied since respondents are not selected by a probability sampling process. A given industry may have 50 respondents which directly report, say, 60 percent of its estimated aggregate value of inventory. Each reported dollar, in effect, is inflated by 1.667 regardless of the size of a firm. Hence, if the industry has a few large firms whose inventories account for a large part of the 60 percent, these completely dominate the estimates.

Occasionally, a large firm experiences an extreme month-to-month change that is not typical of other respondents in its industry; this may be due to a strike or some other unusual event. In that case the firm's report is set aside in the estimation process and a ratio of change is obtained from all other respondents in the estimating cell. The resulting ratio is then applied to the prior-month estimate (excluding the inventory of the firm set aside). A value is obtained for the current month, and the current value for the firm that was set aside is then added. Thus, the atypical large firm does not affect the ratio of change applicable to non-respondents. This is a fairly common procedure for such cases in surveys that are not probability samples.

The benchmark for the monthly M3 survey is the value of inventories obtained from the annual survey of manufactures or from a census of manufactures. When a yearend inventory value is obtained from a benchmark source like the ASM, it is substituted for the value estimated from the monthly survey. Adjustments to monthly data are then made for intervening months. Thus, assume that for a detailed industry December 31 inventories were 100 at the end of year t and through data collected in the monthly M3 survey were estimated at 120 on December 31 of year $t + 1$. Assume that the ASM result for December 31 of year $t + 1$, which becomes available later, is 125. In general, the adjustment procedure involves raising January inventory estimates by one-twelfth of 5, February by two-twelfths of 5, and so on, so that the ASM estimate of 125 will be reached by the end of the year.

Comparison of Annual Changes in Inventory Book Values Compiled in the M3 and ASM

Changes in book values of inventories for selected years compiled in the monthly survey and annual benchmark sources appear in table 3.1. Changes from the monthly survey are shown as they appeared shortly after the close of each year.

Table 3.1. ANNUAL CHANGES IN BOOK VALUES OF MANUFACTURING INVENTORIES COMPILED IN MONTHLY AND ANNUAL SURVEYS

(Billions of dollars)

Year ¹	Monthly Survey (M3) ²	January 1977 Benchmark ³	Difference
1975	-3.6	0.1	3.7
1974	29.5	33.8	4.3
1973	12.9	16.5	3.6
1972	5.3	5.7	.4
1971 . . . . .	.1	1.0	.9
1970	3.7	3.5	-.2
1969	7.3	7.5	.2
1968	5.6	5.9	.3
1967	4.8	6.6	1.8
1966	9.8	9.7	-.1
1965	2.9	3.7	.8
1964	2.0	3.3	1.3

¹Change from December 31 of prior year to December 31 of given year.

²Annual change for the specified year published in March of succeeding year in *Survey of Current Business*. For example, the change for 1974 is taken from the March 1975 *Survey of Current Business*.

³Changes through 1974 appear in the major benchmark revision published in January 1977, which incorporated Census and ASM data. 1975 data are from ASM publication for that year.

The figures under "January 1977 benchmark" are taken from a report containing the major benchmark revision of the monthly M3 survey which was published in early 1977.²

Looking at the two series with hindsight, the differences for years prior to 1973 do not appear to be significant, although the 1964 and 1967 revisions, in excess of \$1 billion, are substantial. The fact that the revisions are almost always upward is somewhat troublesome. However, for 1973, 1974 and 1975, the absolute amount of the revisions is significant, and much of this study is an analysis of factors that contributed to these large differences.

Through use of computer records, attempts were made to compare inventory data reported by establishment in the ASM with data reported by company/division in the M3 survey. This computer tabulation was never successfully completed because of technical problems relating to storage of data, quality of corrections, changes in industry codes, and the like. Computer printouts obtained were flawed so a rigorous systematic analysis was impossible, although the tabulation did reveal the wide variety of problems that can occur when different reporting units are used by large, complex firms.

The substantial revisions of recent years were caused, in large part, by use of different reporting units in the monthly M3 survey, on the one hand, and in the annual survey of manufactures, on the other. The very high inflation of 1973 and 1974

²U.S. Bureau of the Census, *Manufacturers' Shipments, Inventories, and Orders: 1958-1976* M3-1.6 (1976).

was an important contribution to the large revisions because it led to a massive shift to use by firms of the LIFO method, but the degree to which LIFO is used differs between plants and companies.

Reporting units in the ASM are establishments; those in the M3 survey are entire companies or broadly defined divisions. Annual changes in inventories as measured by the ASM have tended to exceed those measured by the M3, even though the reporting unit in the latter is more comprehensive. The company/divisional reporting units used in the M3 survey often include sales branches, separate warehouses, and other kinds of inventory-holding establishments that are not considered operating manufacturing establishments and consequently are not included as reporting units in the ASM. Inventory values of some types of establishments omitted from the ASM are collected on an establishment basis as part of the quinquennial census of manufactures, as indicated below.

Inventory values omitted from the ASM by type of establishment	1972 (billions of dollars)
Operating manufacturing establishments.	108.9
Manufacturers' sales branches.....	8.0
Administrative offices, warehouses, and other auxiliaries.....	5.1
Total.....	122.0

At the end of 1972, inventories at the manufacturing establishment level were \$13.1 billion or 12 percent lower than would be the case if company and divisional reporting units were used in the annual survey.

Firms using the LIFO method often have difficulty reporting values of their inventories below company or divisional levels for periods of less than a year. Since LIFO is adopted mainly to reduce taxes, LIFO firms give greatest emphasis to yearend inventories.

A variety of patterns has evolved in the reporting of inventory statistics in Government surveys. In one pattern firms report in the monthly M3 survey on a LIFO basis while their establishments report in the ASM on a FIFO or other nonLIFO basis. When this occurs and prices of goods in inventories rise substantially, firms will report larger changes in inventories in the ASM than in the monthly survey. Such a reporting pattern, which is discussed in more detail in later chapters, has been common and might be exemplified as follows:

Hypothetical Inventory Reporting Pattern by Type of Inventory

Source	End of Year 1	End of Year 2
FIFO inventory.....	100	120
Less LIFO reserve.....	20	30
LIFO inventory.....	80	90

This firm would report inventories of 80 and 90 in the monthly survey, for a rise of 10 from the end of year 1 to the end of year 2. It would report 100 and 120 in the ASM, for a rise of 20.

For years prior to 1974, the number of firms on LIFO was relatively stable, accounting for about one-sixth of the book value of inventories reported in manufacturing. As rates of inflation accelerated, especially in 1974, there were major shifts to use of the LIFO method and by the end of 1974, about one-fourth of manufacturing inventories reported in the M3 survey were valued by LIFO. Shifts to LIFO persisted in the 1975-77 period, and it is likely that such shifts will continue.

Coverage of the M3 Survey

Since the M3 survey is not a probability survey, coverage of respondents can be measured only in terms of amounts directly reported relative to those for estimated universes. However, obtaining such data is difficult because of maintenance procedures for computer tapes and because reporting units in the M3 survey do not match those in the ASM benchmark sources. Rough estimates, prepared on the basis of data supplied by the Census Bureau for December 1976, are shown below; detailed statistics appear in table 3.2.

Percent Coverage of Manufacturing Sales and Inventories in M3 Survey Relative to ASM

Source	Percent Coverage December 1976
Shipments.....	65
Total inventories.....	63
Inventories with some stage-of-fabrication detail.....	56

The estimated coverage for aggregate inventory is the December 1976 inventory amount tabulated for M3 reporting units divided by the published ASM level of inventory. The comparison is necessarily rough because of inability to exactly match reporting units in the two surveys. Total ASM inventories tend to be high relative to total M3 inventories because a higher proportion of ASM inventories are on FIFO or a FIFO-type basis. On the other hand, inventories for selected firms or divisions in the M3 survey tend to be high relative to reported ASM inventories for the same respondents because the former include inventories at sales branches and at other establishments excluded from the ASM. We are not prepared to estimate the extent to which these factors offset each other. These problems are magnified, of course, when detailed industries are considered.

If M3 sales are divided by ASM sales, true sales coverage is understated because ASM shipments data contain extensive duplication because of intracompany shipments. Such duplication is far greater than any existing for divisional reporting and is more important than any nonmanufacturing reporting included in M3 sales. However, it is possible to infer the sales

from the inventory coverage because all firms reporting inventories report sales but not all firms reporting sales report inventories. Applying this principle to Census data yielded an estimate of 65 percent for sales coverage. That is, measured by reported sales, the percentage of firms reporting inventory is 2 percentage points less than the percentage reporting sales. The same was used to estimate coverage of firms reporting any stage-of-fabrication breakdown.

Table 3.2. ESTIMATED PERCENTAGE OF UNIVERSE TOTALS ACCOUNTED FOR BY RESPONDENTS IN M3 SURVEY REPORTING SHIPMENTS, INVENTORIES, AND INVENTORIES BY STAGE OF FABRICATION, DECEMBER 1976

Industry	Shipments	Inventories	Inventories by Stage of Fabrication
Manufacturing	65	63	56
Durable goods	64	62	54
Lumber	39	33	29
Furniture	21	20	16
Stone	43	42	40
Primary metals	78	77	70
Fabricated metals	37	32	30
Machinery	54	52	37
Electrical machinery	68	68	46
Transportation equipment	102	101	95
Instruments	56	55	53
Other durable goods	26	26	25
Nondurable goods	67	64	58
Food	70	66	53
Tobacco	110	110	100
Textiles	44	42	40
Apparel	20	16	12
Paper	78	71	63
Printing	37	35	30
Chemicals	79	76	75
Petroleum	84	83	78
Rubber	58	56	56
Leather	27	21	21

Source: Unpublished data, Bureau of the Census.

Converting the M3 to a Probability Sample Survey

The present M3 survey is not a probability sample but can be described as a "chunk" survey. All reports collected are used in estimation. Results therefore are different from those that would be obtained if a probability sample were utilized.

The Census Bureau recognized that probability sampling was needed but has been concerned about the ability of small

firms to report on a monthly basis. To investigate this concern, a small sample of relatively small firms was drawn and test mailings were made during the second half of 1974. About 75 percent of firms canvassed reported with very little followup. All those responding reported sales. Fewer reported total inventories and still fewer reported orders data and inventories by stage of fabrication.

Given these test results the Census Bureau decided to proceed with a probability sample. In early 1975, an operation parallel to the basic M3 survey began on an experimental basis. A subsample from the ASM of 2,000 firms with fewer than 1,000 employees was drawn. It was assumed that firms with more than 1,000 employees had already been canvassed as part of the ongoing M3 survey. (However, not all such firms comply with Census Bureau requests to furnish data for the ASM.) The subsample was divided about equally between firms with more and less than 100 employees, but a decision was made to restrict the initial mailout to firms with 100 to 999 employees.

The parallel survey is still continuing but the response rate is a disappointing 50 percent of the initial mailout despite telephone followups made early in the investigation. Respondents in this survey were integrated into the regular M3 survey in January 1978.

Inventories by Stage of Fabrication

A breakdown of inventories by stage of fabrication typically has been a feature of manufacturers' inventory data. Reporting by stage of fabrication always has been part of the monthly survey. The first inventory data in a census of manufactures—1939—provided a partial separation in which finished goods were distinguished from other manufacturing stocks. The first three-way breakdown in a census of manufactures occurred in 1954, two years after the first such separation in an annual survey of manufactures.

A breakdown of inventories by stage of fabrication is needed for deflation and enters specifically into calculations of the inventory change component of the GNP. (Discussed in detail in chapter 4.) Economic analysts recognize that factors governing the behavior of statistics for purchased materials, work in process and finished goods stocks and their changes are different. Students of inventory behavior have made this breakdown central to their analyses—Abramovitz in his pioneering study in 1950,³ Lovell in his econometric studies in the late 1950's and early 1960's,⁴ and to cite a more recent example, Feldstein and Auerbach in their paper presented at the Brookings Institution in 1976.⁵ Popkin has made extensive

³Moses Abramovitz, *Inventories and Business Cycles* (New York: National Bureau of Economic Research, 1950).

⁴For example, Michael C. Lovell, "Determinants of Inventory Investment," in *Models of Income Determination*, Studies in Income and Wealth, Volume 28 (Princeton: National Bureau of Economic Research, 1964).

⁵Martin Feldstein and Alan Auerbach, "Inventory Behavior in Durable Goods Manufacturing: The Target Adjustment Model," *Brookings Papers on Economic Activity*, 2/1976 (Washington, D.C.: The Brookings Institution, 1976).

use of stage-of-fabrication data in his model of final and intermediate demand by stage of process.⁶ "Stage of process" is a term used to differentiate products and industries with respect to final, intermediate and primary markets of the economy as a whole. Application of a stage-of-fabrication breakdown to a stage-of-process framework facilitates analysis of inventory data at various stages of production in basic market classes. For example, it permits analysts to focus on finished goods held by primary producers and those same goods held as purchased materials by consuming industries. When the Securities and Exchange Commission expanded quarterly financial reporting requirements for registered corporations, it included questions on a breakdown of inventories by stage of fabrication in response to requests from securities analysts. There is clearly a long tradition for a breakdown so far as statistical, economic and financial analysis is concerned.

Although it is analytically desirable, actually measuring inventories by stage of fabrication is difficult. As already noted, monthly reporting of inventories by stage of fabrication occurs less frequently than monthly reporting of total inventories. Furthermore, figures by stage of fabrication include those from firms that group together two of the three stages. For example, a firm may report materials separately and combine work in process and finished goods, or may report finished goods separately and combine the other two stages. The incidence of such reporting probably is not great. Nonetheless, the Census Bureau does not consider the monthly stage-of-fabrication breakdowns sufficiently good to warrant publication in more than a few industries in the M3 survey. The list below shows the stage-of-fabrication breakdowns published in the M3.

- Durable goods industries
 - Stone, clay and glass products
 - Primary metals
 - Machinery (electrical and nonelectrical)
 - Transportation equipment
 - All other durable goods industries
- Nondurable goods industries
 - Chemicals and allied products
 - Petroleum and coal products
 - Rubber and plastics products, n.e.c.
 - All other nondurable goods industries

Breakdowns of inventory by stage of fabrication are based on somewhat less reliable samples than are total inventory figures in ASM data. Mean standard errors of estimate (in percent) at the 2-digit industry level for end-of-1975 inventories were as follows:

Total inventories	1.3
Materials and supplies	1.6
Work in process	1.8
Finished goods	2.0

⁶Joel Popkin, "An Integrated Model of Final and Intermediate Demand by Stage of Process," in American Economic Association, *Papers and Proceedings of the Eighty-Ninth Annual Meeting, 1976* (*American Economic Review*, Vol. 67, No. 1, February 1977), pp. 141-147.

Inventory data by stage of fabrication are somewhat ambiguous and imprecise because of integration of production processes within firms and because lines of demarcation between stages are not distinct. For example, there are problems with reporting units of multiestablishment firms that are integrated in some fashion. If inventories by stage of fabrication reported for a company (or a division) are compared with the sum of inventories by stage of fabrication reported by plants or establishments that constitute that company (or division), there may be substantial differences. These arise because finished goods of one establishment are both raw materials of other establishments and the work-in-process inventory of the company (or division). Further, for an industry group as a whole there is no exact definition of inventory by stage of fabrication. The Census Bureau does not define these categories in either the M3 or ASM surveys. Since industry groups tend to be fairly broad, what are finished goods for one company may be work in process for another company within the same industry group.

There are also problems in distinguishing work in process from finished goods. Is the hot rolled sheet in the inventory of a steel firm considered finished goods or work in process if some will be sold as hot rolled sheet and some will be processed further? Respondents in Census surveys may classify the same goods in different ways.

Finally, the breakdown of inventories by stage of fabrication is seriously affected by extensive use of LIFO within an industry. This is obvious in the case of unit method LIFO where one or two raw materials in stock are valued at prices spread over several years in the past while nonLIFO materials and costs are valued at recent prices. Because of pooling, even dollar value LIFO firms may report breakdowns of inventories by stage of fabrication that do not reflect underlying physical distributions. Indeed, many firms using dollar value LIFO are unwilling to provide this breakdown in reports to stockholders. A typical comment comes from Olin Industries in its 1976 annual report: "It is not practical to separate the inventory into its components (raw materials, work-in-progress and finished products) because of the use of the dollar value LIFO method." Of 550 manufacturing firms whose 1976 annual reports to stockholders were analyzed, the American Institute of Certified Public Accountants (AICPA) found that approximately 100 did not provide a breakdown by stage of fabrication. The proportion of LIFO firms in manufacturing that do not provide this breakdown is estimated to be about one-third.⁷

Monthly reporting of stage-of-fabrication separations is much more complex than yearend reporting because breakdowns relevant to plants are not appropriate to companies or divisions. LIFO valuation further complicates the situation. Because stage-of-fabrication measurement problems are intimately related to selection of appropriate reporting units, discussed in chapter 9, conclusions and recommendations for improving data in this area are deferred to that chapter.

⁷Information supplied by the American Institute of Certified Public Accountants to the NBER.

Recommendations

1. The Census Bureau should continue to conduct the annual survey of manufactures using establishment (plants) as reporting units. There is a continuing need for annual establishment data for analyses when the focus is on production, labor, material and energy inputs. However, the monthly M3 survey should not be benchmarked to the ASM and, consequently, a new benchmarking system for the M3, described in detail in chapter 9, is proposed. Briefly, for firms below a certain size, establishment reports in the ASM would constitute their benchmarks. For firms above that size, the Census Bureau should collect, on a mandatory basis, special annual reports, by company and with divisional breakdowns. That is, large firms would submit inventory totals for their domestic operations as well as divisional breakdowns consistent with these totals. Similar reporting by divisions on a monthly basis would also be sought, although the response rate probably will not be as high as for the mandatory annual reporting.

In connection with a revision of its new and unfilled orders series, the Census Bureau in 1977 began to collect company data with divisional breakdowns for annual 1976 sales and end-of-1976 unfilled orders. The favorable response rate to this survey augurs well for inventory data recommendations made in this study.

2. At this point no recommendations regarding problems affecting the valuation of inventories, which occupy a large part of this study will be made. The Census Bureau has already begun some new initiatives regarding valuation and these are discussed in other contexts. Further research on a number of valuation problems, including those relating to inventories by stage of fabrication, is recommended and a proposed questionnaire directed to some of these issues appears as Appendix A.

3. The Census Bureau should convert the M3 survey into a probability sample, which takes appropriate account of "births," the creation of new firms, and "deaths," the demise of existing firms.

4. To improve the response rate among smaller firms, the Census Bureau should develop a simplified form to request sales and total inventory data. At present, new respondents receive a packet containing extensive and complex instructions directed to missile manufacturers or other large defense contractors. These instructions cannot be expected to elicit favorable responses from small producers.

WHOLESALE TRADE

In the case of wholesale trade inventory statistics, two surveys are involved—the quinquennial census of wholesale trade and the Current Trade Report (CTR). In the quinquennial census, reporting units are the establishments. In this census an abbreviated survey, which includes an inquiry on inventories held, is also collected from CAO's and auxiliaries. The Current Trade Report is the monthly survey of merchant wholesalers by which sales and inventory data are collected.

Employer identification units were the reporting and sampling units in the CTR before 1977. However, about 250 firms re-

ported on a divisional basis. In 1977, the Census Bureau introduced a new probability sample for the monthly survey. Reporting units for the revised sample are enterprises for the largest firms and continue to be EI units for small firms. Reporting by division has been continued on a selective basis.

Definition of Wholesale Trade

Several features of industrial classification are important in a definition of wholesale trade and in any discussion of wholesale inventory statistics. First, there are establishments known as manufacturers' sales branches and sales offices. These sell exclusively or mainly products manufactured by their parent firms. A sales branch typically holds substantial inventories whereas a sales office takes orders but holds little or no inventories. When establishments are classified, the SIC includes sales branches and offices in wholesale trade, but when companies are classified these units are not noted separately. In the classification of enterprises a firm can never be a "sales branch firm." If a firm does both wholesaling and manufacturing it can be included under wholesale trade if that activity, somehow measured, is larger than the manufacturing activity. Manufacturers' sales branches are classification anomalies and are regarded as ancillary to manufacturing activities for purposes of categorizing enterprises.

Second, there is an important classification feature, "type of operation," introduced by the Census Bureau decades ago but not part of the SIC. In Census terminology the categories "merchant wholesalers," "manufacturers' sales branches," "petroleum bulk plants," etc., are types of operation, as illustrated by the following:

Classification of Wholesale Trade

<u>SIC</u>	<u>Census (Prior to 1972)</u>
Wholesale	Wholesale
Food	Merchant wholesalers
Motor vehicles	Food
Etc.	Motor vehicles
	Etc.
	Manufacturers' sales branches and sales offices
	Food
	Motor vehicles
	Etc.
	Assemblers of farm products
	Petroleum bulk plants
	Agents and brokers (sell goods owned by others)

Present monthly statistics on sales and inventory cover only merchant wholesalers as defined prior to the 1972 Census of Wholesale Trade. In the CTR, inventory statistics are not collected for other nonmerchant wholesaling types of operations, and so become available only every fifth year when a census is taken. Then, reporting units are the establishments. One consequence of this limited coverage is that BEA has no

current (quarterly or annual) data for nonmerchant wholesalers. BEA staff now must guess at intercensal movements of nonmerchant wholesalers' inventories. An exception is petroleum bulk stocks, monthly quantity data for which are obtained from the American Petroleum Institute and the U.S. Department of the Interior, Bureau of Mines.

Classification changes were made for the 1972 Census of Wholesale Trade and the SIC itself was modified that year. The changes involved shifting a few types of activities from retail to wholesale trade, which, in aggregate, increased estimated wholesale trade sales by about 5 percent. In addition, certain activities that the Census Bureau had previously called nonmerchant wholesale were classified as merchant wholesale. This had the effect of raising estimated sales of merchant wholesalers by another 5 percent. However, the major distinctions between merchant and nonmerchant wholesaling were retained in the revised coding. The changes in type of operation coding introduced for the 1972 census are shown below:

Revisions in Type of Operation Classification

<u>1967 Classification</u>	<u>1972 Changes in Classification</u>
Type of nonmerchant wholesaler	
Agents and brokers	No change. Remains as non-merchant
Petroleum bulk plants	
Owned by refiners	Remains in nonmerchant
Independents	Changed to merchant wholesale
Assemblers of farm products	Entire group changed to merchant wholesale
Manufacturers' sales branches and sales offices	No change except as noted

Note: Exclusions from sales branches were (1) establishments selling appliances directly at retail, and (2) metal service centers of more than 5,000 square feet of floor space were classified as merchant wholesalers.

The exclusions were eliminated and the two categories became sales branches rather than merchant wholesalers.

In 1977 the Census Bureau introduced a new probability sample for the monthly survey in which the 1972 census definition of merchant wholesalers is used.⁸ Thus, although the scope of the survey has been expanded somewhat, certain classes of economic activity defined as wholesale are still being omitted from monthly coverage. The old monthly survey included operations that omitted about 25 percent of total wholesale inventories. The broader definitions now in use shifted about 5 percent of wholesale inventories to merchant wholesale, leaving about 20 percent of total wholesale inventories still uncovered by the monthly survey.

Some Data Comparisons

Sales and inventories for the quinquennial census and the CTR for the last three census years (1963, 1967, 1972) are compared in table 3.3. There is a comparison problem, however, in that the 1972 census was conducted using the new 1972 SIC whereas data from the current monthly survey are compiled on the basis of the 1967 SIC. Reporting establishments in the census were assigned double codes, and sales for 1972 were tabulated using both 1967 and 1972 SIC classifications. Inventories in the 1972 census were tabulated only on the basis of the 1972 SIC. However, 1972 census inventory estimates using the 1967 SIC were prepared specially for this study by Census Bureau staff.

To obtain a comparison of 1972 census inventories of merchant wholesalers and the CTR for 1972, the inventories held by CAO's and auxiliaries supporting merchant wholesale also had to be estimated. The published data available for CAO's and auxiliaries do not distinguish between those supporting merchant wholesale and those supporting nonmerchant wholesale. An investigation revealed that most inventories held by CAO and auxiliary units classified as wholesale, support sales branches of manufacturing firms. Therefore, only 20 percent of the CAO wholesale inventory was assigned to merchant wholesale.

Comparison of sales data, in table 3.3, from the census and monthly surveys clearly shows small differences for 1963 and 1967. In 1972, estimated sales were considerably higher in the census than in the current survey, a difference which remains to be explained.

In a comparison of inventories, the current survey for 1963 was about 7 percent higher than the census and for 1972 it was about 4 percent below. This is a slippage of about 10 percent or 1 percent a year. The tendency of inventory estimates from the monthly wholesale sample to be understated was evidenced also by the results of the probability sample of merchant wholesalers introduced in 1974. The sample was drawn from a universe of merchant wholesalers in business in 1971. The old and the new sample were run concurrently for four months (March through June 1974); from July 1974 onwards, only the new sample was run. What is relevant is that during the four-month overlap period, inventory estimates from the new sample were higher by about 3 percent (\$1.3 billion); sales estimates were virtually identical.⁹

Merchant Wholesale Sales and Inventories Monthly Averages, March-June 1974

(Dollar figures in billions)

Sample	Sales	Inventories
New sample.....	37.7	41.1
Old sample.....	37.7	39.8
Difference.....dollars..	-	1.3
Difference.....percent..	-	3.3

⁸The new sample was introduced in May 1977; the old sample was run concurrently for four months to provide an overlap.

⁹See appendix B for details.

Sample Design and Estimation

The monthly merchant wholesale sample is a highly efficient probability sample and a careful survey of business "births" and "deaths."¹⁰ The essential design feature of the sample is its panel rotation. Small companies drawn in the sample are segregated into four panels. Each panel enters every fourth month, drops out for three months and then re-enters. This pattern is repeated until a new sample is drawn. When a rotating panel unit enters, it reports for the current and prior month. Using a rotating panel, rather than a fixed-sample panel, results in very high theoretical efficiency. Out of a universe of about 350,000 EI units the sample, including very large units that report every month, can be summarized as follows:

Merchant Wholesale Sample Survey Design

Type of Reporting Unit	Number of EI's
Certainty cases	800
These report every month. Each reporting unit represents only itself and has a weight of 1.	
Noncertainty cases	16,350
These are reporting units drawn in the sample in a probability selection process. Each unit drawn has a weight or blow-up factor greater than 1.	
Rotating panels	
Panel A	4,000
Rotating panel, reports for February and January at end of February, then for June and May, then for October and September, then for February and January, etc.	
Panel B	4,000
Rotating panel, reports for March and February, then for July and June, etc.	
Panel C	4,000
Reports for April and March, etc.	
Panel D	4,000
Reports for May and April, etc.	
Other noncertainty cases	350
For a variety of complex technical reasons these firms report every month.	

During the course of a complete cycle over 17,000 EI units submit reports. In the 1974 sample redesign mentioned earlier, a shift in rotation was introduced. There now are three panels so the rotation is one month in and two months out.

¹⁰The sample design and estimation procedure described in this section were in effect prior to revisions published in late 1977.

The Monthly Estimation Process

As with any scientific sampling design, each reporting unit has a weight or blow-up factor, which is the reciprocal of its probability of selection. The certainty cases (large firms) have a weight of one because each unit represents only itself. The remaining cases drawn in the CTR sample have weights which represent the reciprocals of their chance of selection. In the present sample design, segment firms had a chance of selection ranging up to 1 in 64, depending upon size. When the sample was segmented into 4 panels, the blowup factor went as high as 256.

Initially, each value collected is multiplied by its weight (the inverse of the chance of selection) and totaled for kind of business. Then, kinds of business are added to obtain the total for merchant wholesale. In Census Bureau nomenclature these are called unbiased estimates and are designated as:

X'_{ij} Unbiased (blowup) estimate for the i^{th} month from panel j . j relates to panel A, B, C, or D noted above. The superscript ' relates to the current month. Thus, for Panel A, February would be the current month.

$X''_{i-1,j}$ Unbiased estimate for the prior month. When Panel A reports, it does so for both February and January. Thus, for Panel A, the double prime superscript, with subscript $i - 1$, relates to January, the prior month.

Below, the symbol ' will often be referred to as CM, the current month and " as PM, the prior month or $i - 1$.

In addition to unbiased estimates, there are also composite estimates, which are the published estimates. In a procedure employed prior to 1961, one composite estimate was made for each month. This estimate took the form:

$$X_i''' = \alpha \frac{X'_{ij}}{X''_{i-1,j}} X_{i-1}''' + (1 - \alpha) X'_{ij} \quad (1)$$

where

X_i''' is a composite estimate for month i .

$\frac{X'_{ij}}{X''_{i-1,j}}$ is a ratio of change derived from reporting units reporting for, say, February and January. All values in the numerator and denominator are from the same firms.

α is a weight.

The composite estimate (X''') is a combination of two estimates, a simple ratio estimate and an unbiased (reciprocal) estimate, weighted together in the wholesale trade survey with weights of 0.7 and 0.3.¹¹

¹¹A detailed discussion of the methodology for determining the weights can be found in Morris Hansen, William Hurwitz, and William Madow, *Sample Survey Methods and Theory*, Volume 1 (John Wiley & Sons), p. 500 ff.

Table 3.3. SALES AND INVENTORIES OF MERCHANT WHOLESALERS AS COMPILED
IN THE CENSUS AND CURRENT SURVEY
(Billions of dollars)

Year	Sales		Inventory (December 31)				
	Census	Current Survey	Census			Current Survey	Ratio of Current Survey to Census Inventories
			Operating Establishments	CAO's	Total		
1963.....	157.4	160.6	15.0	(NA)	(NA)	16.0	106.7
1967.....	206.1	205.2	21.5	.3	21.8	21.6	100.5
1972.....	321.0	298.2	33.3	.4	33.7	¹ 31.9 ² 33.2	¹ 95.8 ² 99.7

Note: Data from the current survey are based on 1967 SIC classifications.

NA Not available.

¹ Old sample.

² New sample.

Source: National Bureau of Economic Research and special tabulations by the Bureau of the Census.

After a few years of use, it was recognized that this formula did not fully incorporate information for the prior month, X'' (January when the February panel reports) and that a revised composite estimate could better utilize that additional information and improve the theoretical efficiency of estimates. A revised composite estimate was introduced in 1961.¹² In this revised procedure a modified formula (1) becomes the basis for the final composite estimate. This is done by introducing the second unbiased estimate, PM, obtained from the rotating panel for the next month ($j+1$). A final or revised composite estimate (X''') is then obtained via:

$$X_i''' = \beta(X_i''') + (1 - \beta)X_{i,j+1}'' \quad (2)$$

These composite estimates can now be rewritten (omitting the panel subscript designations to simplify notation) as follows:

Preliminary composite, linked to the final composite for the prior month (X_{i-1}''')

$$X_i''' = \frac{\alpha}{\beta} \frac{X_i'}{X_i''} X_{i-1}''' + \left(1 - \frac{\alpha}{\beta}\right) X_i' \quad (3)$$

Final composite

$$X_i''' = \alpha \frac{X_i'}{X_{i-1}''} X_{i-1}''' + \beta \left(1 - \frac{\alpha}{\beta}\right) X_i' + (1 - \beta) X_i'' \quad (4)$$

In wholesale $\alpha = 0.7$ and $\beta = 0.72$. The actual formulas are, therefore:

Preliminary

$$X_1''' = 0.972 \left(\frac{X_1'}{X_{1-1}''}\right) X_{1-1}''' + 0.028 X_1' \quad (5)$$

Final

$$X_i''' = 0.7 \frac{X_i'}{X_{i-1}''} X_{i-1}''' + 0.02 X_i' + 0.28 X_i'' \quad (6)$$

Woodruff discusses the objectives and procedures by which the weights (α and β) were selected.¹³ It might be noted that: (1) each preliminary estimate is essentially a ratio estimate as the weight for the unbiased estimate is negligible (0.028), and (2) weights for the final composite estimate (X''') were selected to optimize each monthly estimate of the level of inventories rather than the month-to-month change.

It is important to note that although this discussion of the monthly estimation process raises a number of interesting technical issues, these are much less important than data problems discussed later in this chapter.

Rotating Panel Bias

A problem that affects monthly estimates is rotating panel bias. This phenomenon is illustrated in table 3.4.

The reporting panels, which are designated as A, B, C, and D, show persistent relations.

- A > B See February, June and October
- A > D See January, May and September
- C > B See March, July and November
- C > D See April, August and December

A and C for this industry are panels which yield high values; B and D are panels which yield low values, simply by the

¹²See Ralph S. Woodruff, "The Use of Rotating Samples in the Census Bureau's Monthly Surveys," *Journal of the American Statistical Association*, Vol. 58, No. 302 (June 1963).

¹³Ibid.

Table 3.4. ILLUSTRATIONS OF PANEL BIAS IN ESTIMATES OF INVENTORIES, GROCERY WHOLESALERS, 1973

(Billions of dollars)

Panel	January	February	March	April
CM (X')	2.8 (D)	3.2 (A)	3.0 (B)	3.3 (C)
PM (X'')	3.1 (A)	2.9 (B)	3.3 (C)	3.1 (D)
PM - CM . . . .	.3	-.3	.3	-.2
	May	June	July	August
CM (X')	3.0 (D)	3.3 (A)	3.0 (B)	3.3 (C)
PM (X'')	3.2 (A)	3.1 (B)	3.3 (C)	3.2 (D)
PM - CM . . . .	.2	-.2	.3	-.1
	September	October	November	December
CM (X')	3.3 (D)	3.6 (A)	3.6 (B)	3.7 (C)
PM (X'')	3.5 (A)	3.4 (B)	3.7 (C)	3.6 (D)
PM - CM . . . .	.2	-.2	.2	-.1

Note: Rotating panels are designated A, B, C, and D.

Source: Unpublished data from the Bureau of the Census.

"luck of the draw." When the new sample was introduced in 1974, a procedure was devised in an attempt to rectify the bias among panels. Census introduced an adjustment procedure employing industry factors for each of the four panels. Results after this adjustment are shown in table 3.5.

Significant elements of panel bias are retained in the new sample even after attempts at correction.

- Panel B > A in all three months
- Panel B > C in two of three months
- Panel D > C in all three months
- Panel D > A in two of three months

The CM/PM Problem

A serious problem in compiling wholesale inventory statistics is that estimates derived from unbiased estimates for the current month, from reports in that month, tend to be lower than estimates derived from reports in the next month on inventories in the prior month. Thus, CM usually is lower than PM for the same month.

Monthly estimates for recent years of inventories for total merchant wholesale trade, not seasonally adjusted, appear in table 3.6. The widest difference between CM and PM values occurred in 1974. The severity of the problem for that year could have been due to the high rate of inflation, probably because firms have book value figures for the prior month but make estimates for the current month that fail to take appropriate account of price increases. In 1975 there was a

Table 3.5. ILLUSTRATION OF ADJUSTMENTS FOR PANEL BIAS IN ESTIMATES OF INVENTORIES, GROCERY WHOLESALERS, 1975

(Billions of dollars)

Panel	January	February	March	April
CM (X')	4.9 (D)	3.9 (A)	4.2 (B)	4.0 (C)
PM (X'')	3.9 (A)	4.2 (B)	4.1 (C)	3.8 (D)
PM - CM	-.1	.3	-.1	-.2
	May	June	July	August
CM (X')	3.7 (D)	3.7 (A)	4.1 (B)	3.9 (C)
PM (X'')	3.7 (A)	4.1 (B)	3.9 (C)	3.8 (D)
PM - CM	-	.4	-.2	-.1
	September	October	November	December
CM (X')	3.9 (D)	4.0 (A)	4.2 (B)	4.2 (C)
PM (X'')	3.8 (A)	4.3 (B)	4.3 (C)	4.1 (D)
PM - CM	-.1	.3	.1	-.1

Note: Rotating panels are designated A, B, C, and D.

Source: Unpublished data from the Bureau of the Census.

negligible difference between CM and PM for wholesale inventories, which may have been associated with the recession and the decline in inventories. The customary relationship resumed in 1976 with CM about 0.6 percent less than PM. The difference averaged more than 1 percent in 1974 and 0.7 percent in both 1972 and 1973.

The CM/PM comparisons shown in table 3.6 are for all merchant wholesalers. Such ratios are more erratic for individual kinds of business.

The CM/PM problem does not seem to exist to any significant extent for wholesale sales. However, in other surveys where similarly designed rotating panel samples are used—retail sales and service receipts—similar relationships between CM and PM for the same month have been found.

The CM/PM relationship has existed for many years. While only recent data are presented here, the problem has endured at least since the early 1960's, and probably before that. The question is: "Are CM's low estimates or are PM's high estimates?" Research has suggested that CM's are too low. With the early timing of the survey (closeout is attempted around the 20th of a month) some respondents give estimates for the current month (CM) before book data are ready. In a rotating panel design, such firms cannot correct estimated inventories when book numbers become available because they drop out of the sample for three months. For example, in the wholesale recordkeeping survey all respondents in the June 1974 panel were asked, several months later, to give their best values for end-of-May-and-June inventories. The results were retabulated:

Month	Original	Revised	Difference: revised less original
(Billions of dollars)			
June	40.5	41.1	0.6
May	40.3	40.7	.4

While there were individual changes in both directions, on balance, data for both months were revised upward, but the CM for June was revised upward by more than the PM for May. Moreover, when new samples are introduced, there generally are upward revisions of wholesale inventories. Thus, it appears reasonable, even though the evidence is not strong, that PM's are the better estimates.

The CM/PM Problem and the Composite Estimate

Preliminary Composite Estimate—Formula (5) for preliminary composite inventory estimates is essentially a ratio estimate because the unbiased estimate X' receives little weight. Since CM tended to be low in relation to PM from the sample panel, the preliminary composite estimate for each month tended to be low and had to be increased by the final composite.

The persistently low preliminary composite estimates were an embarrassment. As a result, a regression adjustment by kind of business was introduced in 1969 based upon historical patterns of upward revisions in final composite estimates. The preliminary composite adjusted estimates then became better predictors of the final composite.

When the new sample for merchant wholesalers was introduced in early 1974, the regression adjustment to preliminary composite estimates of inventories was not made in the hope that the CM/PM bias would be resolved. By late summer 1974, however, it was clear that CM/PM bias still existed in the new sample, so the regression adjustment was reinstated in September 1974. To illustrate, 1976 data for total merchant wholesale inventory are shown in table 3.7. In 1976, the preliminary composite before adjustment (column A) was always below the final composite (column C). After adjustment, the preliminary composite (B) was always closer to the final except in August. Although differences may appear small, they become more important when month-to-month changes are examined. Each such change is shown on three bases in table 3.7. From May to June, for example, the preliminary composite yielded a change of \$0.3 billion, which was raised to \$0.5 billion by the regression adjustment. The final change was \$0.6 billion.

Final Composite Estimate—As noted above, the wholesale inventory survey is subject to a systematic tendency in which the CM unbiased estimate (X') is almost always less than the PM unbiased estimate (X''). As a result the final composite estimates are too low in level. To illustrate the impact of this, the following hypothetical situation is used, together with equation (6).

Table 3.6. MERCHANT WHOLESALE INVENTORY, UNBIASED ESTIMATES, 1974-1976

(Billions of dollars, not seasonally adjusted)

Month	CM (X')	PM (X'')	PM - CM
1974			
January	38.5	40.0	1.5
February new . .	39.9	40.8	.9
March sample . .	41.2	41.5	.3
April	41.3	41.0	-.3
May	41.1	41.3	.2
June	41.6	42.7	1.1
July	43.4	43.2	-.2
August	43.1	43.1	-
September	43.9	43.9	-
October	45.5	46.4	.9
November	47.1	47.3	.2
December	47.1	47.6	.5
Monthly average ¹	42.8	43.3	.5
1975			
January	47.5	46.5	-1.0
February	45.8	46.5	.7
March	46.2	46.4	.2
April	45.7	46.3	.6
May	45.1	45.0	-.1
June	44.7	44.7	-
July	44.7	44.9	.2
August	45.1	45.2	.1
September	45.2	44.9	-.3
October	45.8	45.6	-.2
November	45.7	46.2	.5
December	45.8	45.9	.1
Monthly average ²	45.6	45.7	.1
1976			
January	46.1	46.2	.1
February	46.5	47.2	.7
March	47.3	47.4	.1
April	47.1	47.6	.5
May	47.8	48.2	.4
June	48.4	48.7	.3
July	48.7	49.1	.4
August	48.8	48.5	-.3
September	48.8	49.6	.8
October	50.4	50.5	.1
November	51.1	51.3	.2
December	51.0	51.2	.2
Monthly average ³	48.5	48.8	.3

¹ Ratio of monthly average (PM ÷ CM) 1.012.

² Ratio of monthly average (PM ÷ CM) 1.002.

³ Ratio of monthly average (PM ÷ CM) 1.006.

Source: Based on unpublished Bureau of the Census data.

Table 3.7. MONTHLY COMPOSITE ESTIMATES OF MERCHANT WHOLESALE INVENTORIES AND THEIR CHANGE, 1976

(Billions of dollars)

Month	Preliminary Composite		Final Composite	Monthly Change		
	Before Adjustment	Adjusted		A _{m+1} Minus C _m	B _{m+1} Minus C _m	C _{m+1} Minus C _m
	(A)	(B)					(C)
January	45.8	45.9	45.9			
February	46.3	46.4	46.6	0.4	0.5	0.7
March	46.7	46.8	46.9	.1	.2	.3
April	46.7	46.8	47.0	-.2	-.1	.1
May	47.2	47.3	47.4	.2	.3	.4
June	47.7	47.9	48.0	.3	.5	.6
July	48.1	48.4	48.4	.1	.4	.4
August	48.1	48.4	48.2	-.3	0	-.2
September	48.6	48.7	48.9	.4	.5	.7
October	49.7	50.0	49.9	.8	1.1	1.0
December	50.4	50.6	50.7	.5	.7	.8

Source: Basic data from Bureau of the Census. Data in column A unpublished.

Assume CM or X' is always tabulated as 99 and the PM or X'', the correct value of inventory, is always tabulated as 100. (This example is an exaggeration of the actual CM/PM problem—which is probably around 0.7 percent—but it provides hypothetical values that are easy to work with and to understand.) Therefore, data inputs to formula (6) for deriving the final composite estimate are:

Period	X'	X''
1	99	100
2	99	100
3	99	100
etc.		

Assume further that the composite estimation process is begun with a correct value of 100. The ratio for the first term in the formula will always be 0.99. The results follow:

Period	Substitution in Formula	Final Composite Estimate
0		100.00
1	$0.7(0.99)(100) + 0.02(99) + 0.28(100)$	= 99.28
2	$0.7(0.99)(99.28) + 0.02(99) + 0.28(100)$	= 98.78
3	$0.7(0.99)(98.78) + 0.02(99) + 0.28(100)$	= 98.43
4	$0.7(0.99)(98.43) + 0.02(99) + 0.28(100)$	= 98.19
.	.	.
.	.	.
.	.	.
13	$0.7(0.99)(97.69) + 0.02(99) + 0.28(100)$	= 97.68
14	$0.7(0.99)(97.68) + 0.02(99) + 0.28(100)$	= 97.67
15	$0.7(0.99)(97.67) + 0.02(99) + 0.28(100)$	= 97.67

Because the results are rounded to two decimals, after the 14th month the rounded final composite estimate will remain at 97.67. If additional digits were used the result would continue to decline by imperceptible amounts.

The phenomenon just described in a hypothetical setting is demonstrated in table 3.8 which uses wholesale trade inventory

Table 3.8. COMPARISON OF FINAL COMPOSITE ESTIMATES OF WHOLESALE INVENTORIES WITH CM AND PM, 1976

(Dollar figures in billions)

1976	Final Composite	CM(X')	PM(X'')	CM PM
January	45.9	46.1	46.2	0.998
February	46.6	46.5	47.2	.985
March	46.9	47.3	47.4	.998
April	47.0	47.1	47.6	.989
May	47.4	47.8	48.2	.992
June	48.0	48.4	48.7	.994
July	48.4	48.7	49.1	.992
August	48.2	48.8	49.5	1.006
September	48.9	48.8	49.6	.984
October	49.9	50.4	50.5	.998
November	50.7	51.1	51.3	.996
December	50.6	51.0	51.2	.996
Monthly average .	48.2	48.5	48.8	.994

Source: Bureau of the Census. CM and PM are unpublished.

data. The final composite estimate is actually below the level of CM (X') in 10 of 12 months and always below the PM (X"). The monthly average of the final composite is \$0.6 billion below the monthly average of the PM.

CM/PM Identicals

Related to the CM/PM problem are instances in which identical values are reported for the current and previous month by firms in the rotating panel. In these cases respondents probably do not have actual book values for the current month and simply repeat prior-month values of inventory. The identical value problem for CM and PM does not arise for sales, but is confined to inventories.

Reports with identical inventory values for the current month and the prior month sometimes contain heavily rounded numbers. The CTR survey is operated on a tight time schedule. If reports are not received in the mail by the 18th or 19th of a month, respondents are telephoned. About 40 percent of the individual returns are collected by telephone, and it appears that rather than completing the forms in writing, many firms simply wait for the call. Study of these reports, conversations with staff members who are familiar with field office operations, and telephone calls made to respondents have led to the conclusion that many of the identical, reported inventory values are casual responses. Respondents, eager to conclude conversations with Census field office staff members, answer with: "Same as last month."

Identical CM/PM inventory values account (after weighting) for 6 or 7 percent of total inventory in most months. During months in which inventory values, in fact, are rising because of physical volume or price increases, these identicals retard the measured increase. The reverse, of course, is true in months of decline. It might be more efficient to treat these identical values as nonresponses and to impute values for them similar to the way the Census Bureau handles ordinary nonresponses. In early 1976, Census began making parallel tabulations, treating these identical values as nonresponses. Results for total merchant wholesale are shown in table 3.9. The identical aggregate was taken for February as a start and, for the period shown, data were tabulated independently. As expected, special tabulations in which CM/PM identicals were treated as nonresponses yielded higher composite estimates. The differences, however, were small. After 15 months, inventories estimated through the special tabulation were only \$110 million above those based on the normal procedure.

Response Rates and Field Office Collection

Monthly Current Trade Reports are collected in 12 regional offices. They are mailed in bulk to Jeffersonville, Indiana, where a large processing office is maintained by the Bureau of the Census. They are punched in Jeffersonville and the data transmitted electronically to a computer in Washington, D.C.

The field closeout is around the 22nd of each month, and telephoning nonrespondents begins around the 20th. Some large "must" cases are followed up for a few days after the 22nd and their data are transmitted to Washington by telegram.

Table 3.9. EFFECT OF TREATING "IDENTICALS" AS NONRESPONDENTS IN WHOLESALE INVENTORY SURVEY, MARCH 1976-MAY 1977

(Billions of dollars)

Month	Standard method (A)	Identicals as nonresponse (B)	Difference B - A (C)
1976			
March	46.86	46.84	-0.02
April	46.96	46.92	-.04
May	47.42	47.52	.10
June	48.03	48.14	.11
July	48.28	48.43	.15
August	48.23	48.32	.09
September	48.93	49.03	.10
October	49.87	49.97	.10
November	50.74	50.83	.09
December	50.65	50.70	.05
1977			
January	51.49	51.51	.02
February	52.18	52.20	.02
March	53.08	53.14	.06
April	52.99	53.09	.10
May	P52.41	P52.52	.11

^PPreliminary composite; all other values are the final composite.

Source: Special tabulations by the Bureau of the Census.

Computer punching is completed in Washington by the 26th. Two edit cycle runs are made to identify odd relationships; reported data can be validated or corrected on the basis of telephone contacts with firms from Washington. Tabulations ordinarily are made during the first two days of the succeeding month.

Reports from about 60 of the largest firms are collected through Washington rather than at field office levels. On average, a field office is responsible for about 500 cases although this varies considerably. New York, for example, may have responsibility for double that amount and Seattle for half.

In the processing an imputation is made for each nonresponse case. This is done by carrying forward the latest figure reported by a nonresponding firm and adjusting it by the average change for responding firms in its type of business. In some cases, the Census Bureau may have to go back several years to a figure reported by the firm in the most recent census. Table 3.10 shows monthly nonresponses in 1975 and 1976 for which sales and inventory data were imputed. (Census also makes imputations for respondents whose reports are rejected; the data in table 3.10 apply to all imputations, which differ only slightly from data for nonresponse cases.) As of the third quarter of 1976 the monthly response rate in the CTR for sales was about 90 percent and for inventories, about 80 percent. Im-

Table 3.10. PERCENTAGE OF SALES AND INVENTORIES IMPUTED IN WHOLESALE TRADE

Month	1975		1976	
	Sales	Inventories	Sales	Inventories
January	11	25	11	23
February	10	23	12	23
March	15	25	14	22
April	11	24	13	23
May	11	23	10	21
June	9	21	11	19
July	10	22	11	21
August	11	23	10	20
September	11	23	10	19
October	10	22	10	18
November	14	26	—	—
December	14	28	—	—

Source: Memorandum by Louis Shapiro, Business Division, Bureau of the Census, September 23, 1976.

putations of inventory amounts for small firms are relatively greater than for large firms, as table 3.11 indicates.

Statistics in table 3.12 are extracted from research done by Bureau of the Census staff to discover why firms either did not respond to the February 1976 CTR or reported sales but not inventories. Most firms contacted reported sales only. An important phase of the research was a telephone followup of firms not reporting inventory for February 1976. At the beginning, only firms with more than \$10 million in inventory were telephoned. However, because of the success of the experiment, the followup was extended to firms with \$1 million or more in inventory. This Census research confirmed the view that response rates could be improved by more persistent followups of nonrespondents.

Of 224 firms telephoned to obtain end-of-February inventories long after the end of the month, data were obtained from 35 with inventories of \$10 million or more and from 97 with

inventories of \$1 million to \$10 million. Twenty-four other firms were determined to be out of business. More than half the imputed inventory values were clarified by these telephone calls, including 35 of 39 of the larger firms.

It is clear from this Census Bureau survey that large companies who do not supply monthly inventory statistics possess such figures although they may become available somewhat late for the timing of the CTR. Hence, revised estimates of higher quality can be obtained by surveying such firms later and including these inventory data in subsequent estimates. Also, nonrespondent firms contacted by the Census Bureau for February 1976 information were asked to report on a regular basis; there was an apparent improvement in response rates. Reporting units with more than \$1 million in inventory had a distinctly better response rate by late summer as a result of the followup.

Recommendations

1. Annual Benchmark

A fundamental modification should be made to obtain annual benchmarks for wholesale trade¹⁴ similar to programs used in manufacturing and retail trade. An annual survey should be conducted promptly after the close of a year to establish benchmarks for December 31 inventories. As these benchmark values become available, monthly estimates between benchmarks could be revised to December 31 values by a procedure that retains the essence of month-to-month changes obtained from monthly data collected in the CTR. (The annual benchmark survey should also include annual sales from the prior year as benchmarks for monthly sales estimates.)

The annual benchmark survey should cover substantially more firms than the monthly survey and should be mandatory. Since this annual survey would be taken a few weeks after the close of a year, many reporting problems encountered in the

¹⁴A new benchmark survey has already been started. In early 1978 the Census Bureau conducted a mandatory sample survey for 1977 sales and December 31, 1977 inventories.

Table 3.11. IMPUTATIONS BY INVENTORY SIZE OF WHOLESALE TRADE REPORTING UNIT, SELECTED MONTHS, 1976

Inventory size (thousands of dollars)	Imputed amount in October (billions of dollars)	February	April	June	September	October
		(Percent)				
Under 100	1.2	41	37	35	37	32
100 to 199 . . . . .	.8	32	36	30	34	25
200 to 499	1.6	29	31	28	23	25
500 to 599	1.2	19	25	26	25	25
1,000 to 4,999	1.9	19	24	17	18	16
5,000 or more	2.3	19	13	10	10	14
Total	8.9	23	23	19	19	18

Source: Memorandum by Louis Shapiro, Business Division, Bureau of the Census, September 23, 1976.

Table 3.12. FOLLOWUP SURVEY OF WHOLESALE TRADE FIRMS NOT SUPPLYING INVENTORY DATA FOR FEBRUARY 1976

(By inventory size)

Inventory size (millions of dollars)	Number of firms	Amount of inventory (billions of dollars)	
		Imputed	Actual
Total.....	332	5.10	(NA)
10 or more.....	51	2.40	(NA)
1 to 10.....	281	2.70	(NA)
Telephone contact made.....	224	4.02	(NA)
February inventory data obtained.....	156	3.15	3.03
10 or more.....	35	1.99	2.02
1 to 10.....	97	.89	1.01
Out of business.....	24	.27	0
February inventory data not obtained.....	68	.87	(NA)
10 or more.....	4	.12	(NA)
1 to 10.....	64	.85	(NA)
Telephone contact not made.....	108	1.08	(NA)
Unable to contact.....	6	.06	(NA)
10 or more.....	0	0	(NA)
1 to 10.....	6	.06	(NA)
No attempt to contact (reserve list).....	102	1.02	(NA)
10 or more.....	12	.29	(NA)
1 to 10.....	90	.73	(NA)

NA Not available.

Source: Memorandum by Louis Shapiro, Business Division, Bureau of the Census, September 23, 1976.

monthly survey would be solved. Respondents would be finished with their annual inventory accounting and would have made needed yearend adjustments. In the long run, an annual survey of this type will also offer a vehicle for the collection of important auxiliary data on related subjects such as orders received and orders placed, and inventory and sales by type of product. For very large firms that currently provide no monthly data whatever, information could be requested on monthly sales and inventories retrospectively.

2. The Monthly Survey

With an annual benchmark survey providing high-quality estimates of inventories at yearend, the heavy emphasis of the monthly Current Trade Report on estimates of inventory levels could be shifted to estimates of month-to-month changes. It is conceivable that the number of respondents in the monthly survey could be reduced somewhat to offset some added costs of the annual benchmark survey.

The major issue with respect to obtaining statistics of an acceptable quality on month-to-month inventory changes relates to the CM/PM reporting problem. The panel rotation scheme now in use (recently modified from four to three rotating panels) does not seem to work. Ever since the survey was begun in the 1950's, CM estimates have been lower than PM estimates. Although there is high technical efficiency in a rotating-panel sample design, for wholesale inventories the response bias evident with this type of panel rotation (in one month, out three months) overwhelms technical gains of a theoretically lower sampling variance.

A similar CM/PM relationship could exist in some other form of sample design. Hence, a sampling procedure should be designed so revised figures from respondents can be obtained if they have provided estimates instead of actual current-month values. This means that noncertainty respondents should report for an extended sequence of months and should be asked to revise earlier estimated values for which book numbers or better estimates later become available. Also, delaying the timing of preliminary tabulations a few days or a week may result in higher quality responses.

Using an independent fixed-panel reporting system to estimate inventory changes is statistically less efficient than a system of rotating panels and could cause estimated inventory levels to drift away from their true values.¹⁵ But such an independent system—one without a periodic benchmark—is not recommended here. Instead, the system proposed includes procedures for obtaining December 31 benchmark estimates from large, mandatory, high-quality annual benchmark surveys. To judge from the timing of the annual retail trade survey, which serves a similar purpose for retail inventories, wholesale trade benchmarks would be available eight or nine months after the end of a year.

The recommended sample design falls between a fixed panel and the present rotation system. A modified panel rotation system is that noncertainty firms would be in the monthly survey for six to eight consecutive months and then drop out. Every second or third month a new panel or segment of the universe would be added to replace an old segment. Such a system would retain some advantages of panel rotation and allow composite estimates to be made. More important, the CM/PM problem would be eased because respondents would have time to revise estimates. Thus, a respondent who enters the sample in February would be asked to report for January and February. When the March report comes due, the respondent either should be given his or her February figure and asked to revise it if necessary, or requested to provide a February figure independent of what was previously reported.

The survey should also be conducted so that both large and small firms would be able to report sales by the due date, and inventory later if necessary. As indicated above, some firms report sales and not inventories. If inventory data are obtained later than sales data, tabulation and revision procedures should be changed so inventory values can be utilized even if reported late.

¹⁵See table 2 in Woodruff, *op. cit.*

3. Field Operations

Some elements of the monthly wholesale survey and its annual counterpart recommended above should be conducted from Washington, even though there are advantages to a decentralized data collection system. Field office staff can often elicit good cooperation from local businesses and can discover more easily the true identity, actual location, and kind of business of "births" (new firms) and "deaths." Field staff can more readily make allowances for unusual situations that could affect reporting or data accuracy. However, the wholesale trade survey is only one of several surveys that field offices are required to process. Field office staff frequently do not have the training necessary to solve difficult problems that involve large firms whose operations cross major industry divisions or who have adopted LIFO.

On balance, more accurate results might be obtained by moving some report collection to Washington, D.C. Reports from about 60 of the largest firms are already collected from Washington. If this number were expanded, more complete and accurate data could be obtained because of the Washington staff's greater experience in handling complicated procedures.

4. Standard Industrial Classification

Sales offices and sales branches should not be classified under wholesale trade in the Standard Industrial Classification system, but rather as components of manufacturing. In addition, the scope of the monthly and the annual wholesale trade surveys should be expanded to cover wholesale trade in its entirety.

That is, petroleum bulk plants owned by refiners and wholesale activities of agents and brokers also should be surveyed.

RETAIL TRADE

Retail inventory data are gathered in two surveys: the monthly Retail Inventory Survey (RIS), currently collected by Census but published by the Bureau of Economic Analysis, and the Census Bureau's annual retail trade survey (ARTS). The annual retail trade survey is the most authoritative source for retail inventory statistics because retail inventory data are not collected in the quinquennial census of retail trade. Some basic information on these surveys is summarized in table 3.13.

Annual Retail Trade Survey

The ARTS is a large probability sample consisting of 3,600 certainty cases and 24,000 noncertainty cases. Noncertainty cases represent two of four rotating panels used in the Current Retail Trade Survey, the basic source of monthly retail sales estimates. Reporting units are enterprises in the case of Group II reporters (firms with 11 or more stores) and EI units in the case of Group I stores (firms with less than 11 stores). Some large firms submit more than one report within a designated reporting unit because their operations cross industry divisions or because they are involved in two or more kinds of business that need to be reported individually. This is a form of divisional reporting.

Table 3.13. SURVEY CHARACTERISTICS IN RETAIL TRADE AS OF 1976

Survey	Frequency	Data Items	Reporting Unit	No. of Units	Type of Sample	Type of Estimate
Retail Inventory Survey (RIS)	Monthly	Inventory	Enterprise if Group II,* occasional exception, see text. EI if Group I.	150 certainty, 2,200 noncertainty.	Probability sample. Half of noncertainty cases replaced each year. No birth supplementation.	Simple ratio link relative estimate with annual benchmark from ARTS resetting December 31 level each year.
Annual Retail Trade Survey (ARTS) .	Annual	Sales, purchases, inventory.	Same as RIS above.	3,600 certainty, 24,000 noncertainty.	Probability sample. Certainty cases and two of the four panels from the Current Retail Trade Survey.	Simple blowup by reciprocal of probability of selection.
Current Retail Trade Survey	Monthly	Sales and credit.	EI units.	3,600 certainty, 48,000 noncertainty with four rotating panels 12,000 each.	Probability sample. Certainty cases and one rotating panel of about 12,000 report each month. Birth supplementation.	Composite estimates as described in the wholesale discussion, weights are α 0.80, β 0.82.

*Group II consists of enterprises with 11 or more stores.

The ARTS is a mandatory survey, which is mailed during January and collected over the next few months. This is the kind of annual survey, recommended elsewhere for wholesale trade, in which ending inventory for a year is reported after firms have closed their books and figures are "final." Small firms who may not keep monthly figures usually have an end-of-year inventory value for tax purposes.

The ARTS does not include business failures that occur early in a year. That is, if a firm is in business for only a few months, say, from January to May, no attempt is made to obtain a sales report from it nor are sales imputed for its few months of operations. As a consequence, sales are understated slightly. End-of-year inventories, however, are unaffected.

Fiscal Year Reporting

In the ARTS, firms are permitted to report inventory data for the end of their fiscal years and Census has accepted such data without adjustment. Special tabulations of the 1971 ARTS revealed that more than 19 percent of inventories reported came from firms who used fiscal years that ended on a date different from the calendar year—38 percent for Group II reporters and 11 percent for Group I reporters. By 1974, fiscal year reporters had increased to 28 percent. For some kinds of business, like general merchandise, fiscal year proportions in 1974 ranged as high as 61 percent.

That fiscal year reporting is relatively common in retail trade has special significance for inventory data for two reasons. First, since the monthly RIS is benchmarked to the ARTS, problems may arise when the change in inventories from December to December differs significantly from the change from the beginning to the end of the fiscal year, other things being equal. For example, from December 1975 to December 1976 retail inventories rose by \$6.8 billion. From January 1976 to January 1977 (January is a common fiscal year ending for department stores) the rise was \$8 billion. Second, firms may make many adjustments in their inventories when they close their books for the year, so that the change in the book value of stocks from the preceding month (quarter) to the last month (quarter) of the fiscal year reflects more than just later quantities and later prices. This problem is discussed in chapter 8 on interim reporting.

The Monthly Retail Inventory Survey

The RIS is also a probability sample but is far smaller than the ARTS. The same kind of reporting unit is used as in the ARTS but only 150 firms are surveyed with certainty and 2,200 with noncertainty. Newly established firms are not added during the course of the year.

Half the noncertainty cases are replaced each year by using the previous year's ARTS as the basis for selection. Collection of ARTS returns is generally completed by May or June and shortly thereafter computer records become available. Rotation for the RIS is done by kinds of business. To illustrate, assume KB's are arranged into groups A and B. In October of one year the Group A sample is completely replaced by a new sample; the next year the KB's in the Group B sample are replaced, and

so on. Once firms are drawn they are in the survey for two years before being rotated out.

Estimation is by a simple ratio link-relative procedure described in the section on manufacturing. The estimate of inventories for each month is derived by multiplying the prior month estimate by the ratio of change for cases reporting both the prior and current month. This is done by detailed kinds of business. The end-of-year benchmark figure from the ARTS, which becomes available each year roughly in August, is the basis for revising monthly data.

Some Definitions

The RIS asks that merchandise on hand at the end of a month be reported at cost value. "Merchandise on hand" is a term used by large retailers to distinguish it from "merchandise on order."

Through the ARTS the Census Bureau asks that merchandise inventories include stocks (valued at cost) held for sale through retail stores and in warehouses which supply firms' stores. While it is important to preserve the distinction between merchandise on hand and merchandise on order, it would also be worthwhile to request, through both the RIS and ARTS, statistics on merchandise owned by firms wherever located. This would be a problem for large firms. Results of a 1974 record-keeping survey by the Census Bureau indicated that somewhat less than 50 percent of goods being added to inventories were added when actually received. About 15 percent were added when the invoice was received and somewhat more than 15 percent when bills were paid.

On the report form used for the monthly Retail Inventory Survey only the value of inventory in the current month is requested. A shuttle form was used in the past; each of the respondents was sent a form showing the values reported by the firm in earlier months. However, Census Bureau staff believed that a "clean" form might produce better results. They conducted a one-year test in which half the panel were sent forms with no information for earlier months and half were sent shuttle forms with previously reported figures. At the conclusion of the test period it was determined that using the clean form was much easier operationally and that this advantage outweighed any potential gain in quality of reporting. A clean form is now used for the entire sample.

Response Rates and Reporting Problems

In the monthly Retail Inventory Survey, overall response rates, based on the value of inventories, were last calculated for the period December 1974-May 1975. For these six months the results were fractionally below 80 percent of estimated aggregates, that is, the nonresponse rate was slightly above 20 percent of the total value of retail inventories. Census staff members familiar with survey operations believe that a non-response rate of 20 percent for inventories has continued in the monthly survey. In contrast, the nonresponse rate in the monthly retail sales survey was 9 percent in 1975. The non-response for inventory in the ARTS is about 5 percent, or about one-fourth the nonresponse of the monthly inventory survey.

There is only a limited breakdown of nonresponse by sales or inventory size categories; the only information of this type available relates to the distinction between Group I (less than 11 stores) and Group II (11 or more stores). In the six months from December 1974 through May 1975, Group II stores had a nonresponse rate of 14 percent and Group I, of 24 percent.¹⁶ The pattern of nonresponse by size of respondent apparently is similar to that for wholesale trade, with a nonresponse rate of roughly 15 percent for the largest firms and a rate of perhaps 35 percent or more for the smallest.

The overall nonresponse rate of about 20 percent for monthly retail inventories is not significantly different from the rate for wholesale trade. However, there is a quantum difference in sample size. In retail, about 2,350 firms are canvassed each month whereas in the wholesale survey more than 5,000 are canvassed each month and 17,000 over a 4-month cycle.

The response rate in retail has shown a considerable improvement in recent years. In a 1974 Census Bureau memorandum¹⁷ a nonresponse rate of 30 percent or more is cited for 1972. The decrease to the present rate of about 20 percent reflects improvements for both Group I and Group II stores and in both durable and nondurable goods. Census staff have made a conscious effort to improve monthly retail reporting, as is apparent from a comparison of the rate of reported identical values for wholesale and retail trade. In wholesale trade perhaps 7 percent of the reported values for adjacent months are identical, whereas retail, tabulations for one month produced a 2 percent rate. The difference is due largely to the nature of operations in retail trade where identical values are questioned by Census. In some cases, identical values are rejected and treated as nonresponses. The use of a form on which the respondent does not see figures for two months at the same time may also contribute to the lower rate of identical values for retail. An examination of Group I results using the old shuttle form shows that use of the form

... apparently created some reporting bias since it was noted that about 25 percent of the reporting panel reported identical figures for 3 or more consecutive months, about 10 percent reported identical figures for 6 or more consecutive months and about 5 percent reported identical figures for 12 or more consecutive months.¹⁸

Tabulation and Publication of Monthly Retail Inventories

Monthly retail inventory data currently are published by the Bureau of Economic Analysis and not by the Bureau of the Census. Census collects and tabulates the data by nine KB's and by Group I and Group II designations within each KB. The tabulations include inventory values inflated by weights that are reciprocals of the probability of selection for those firms reporting in both the current and prior months. Ratios

¹⁶These data are extracted from a Census Bureau memorandum of September 3, 1975 from Paul Brower to Irving True.

¹⁷Memorandum of March 12, 1974 from Louis Shapiro, Business Division, to Melvin A. Hendry, Chief of the Business Division, Bureau of the Census.

¹⁸Ibid.

of change are provided to BEA by the Census Bureau and the link-relative procedure described earlier is applied by BEA. A firm that has not reported for adjacent months is omitted from the tabulation.

Comparison of Results for RIS and ARTS

In the six years from 1970 through 1975, inventories, as reported annually in the ARTS, have exceeded those reported at yearend in the monthly inventory survey from \$1 billion to about \$2.5 billion in all but one year. Only for 1974 did the monthly survey record a larger rise than the ARTS (see table 3.14). While the differences have not been large relative to levels of inventories, they have been substantial relative to annual changes. Furthermore, large understatements occurred at critical times: In 1972 and 1973, inventories rose by \$3.3 billion more than was reported in the monthly survey for those two years. To some extent, the deteriorating retail situation in 1973 and early 1974 was not fully appreciated because of faulty inventory data.

Our research has not revealed why the monthly and annual surveys yield such different results. In this respect, no new findings have been added to what the Census Bureau determined from recent investigations. There are probably many reasons for the differences with none predominating. But, the fact that the ARTS usually, but not always, yields a larger change is a source of frustration. If it were always larger, it would be possible to make, with some confidence, a bias adjustment to the monthly survey.

BEA began making bias adjustments to the monthly retail inventory change in April 1974 (data month), adding \$65 million per month to the monthly survey results. When the ARTS for 1973 became available at the end of 1974, BEA made the adjustment for all months in 1974, so that the first published end-of-year inventory for 1974 included a bias adjustment of \$780 million ($12 \times \65 million). This adjustment was continued through March 1975. By the spring of 1975, the Census Bureau was able to provide BEA with some very preliminary ARTS data for 1974, but these indicated that BEA retail inventory changes were too high. Consequently, BEA began to eliminate the bias adjustment on a gradual basis. The adjustment was cut to \$32 million for April and May 1975 and then to zero. However, after the 1975 ARTS results became available, BEA resumed bias adjustments in October 1976 at \$100 million per month.

Potential Sources of Bias in Retail Inventory Data

The uneven quality of inventory statistics supplied by small retailers has been a source of deep concern in the Census Bureau. In a 1960 study, the Bureau found that of inventories reported by Group I firms in the monthly survey, only 22 percent were based on "book figures," 37 percent were "estimates based on records," while 41 percent were "estimates not based on records."¹⁹

¹⁹Memo prepared by Louis Shapiro, Business Division, Bureau of the Census, February 2, 1973.

Table 3.14. ANNUAL CHANGE IN BOOK VALUE OF INVENTORY COMPILED IN MONTHLY AND ANNUAL RETAIL INVENTORY SURVEYS

(Billions of dollars)

Year ¹	Monthly Survey (RIS)			Annual Survey (ARTS)		Differences	
	Initial Results (A)	Bias Adjustment (B)	Published (C)	First Published (D)	Later Revision (E)	D - C (F)	E - C (G)
1976.....	7.5	0.3	7.8	7.2	(NA)	-0.6	-
1975.....	-1.2	.3	-9	1.1	(NA)	2.0	-
1974.....	8.9	.8	9.7	8.4	8.2	-1.3	-1.5
1973.....	6.7	0	6.7	8.1	7.9	1.4	1.2
1972.....			2.4	4.0	4.5	1.6	2.1
1971.....			3.6	5.5	5.8	1.9	2.2
1970.....			0	1.2	1.1	1.2	1.1
1969.....			2.9	2.9	3.3	0	.4
1968.....			3.3	3.6	3.0	.3	-3
1967.....			-3	1.0	-	1.3	-
1966.....			2.4	3.6	-	1.2	-
1965.....			2.7	3.2	-	.5	-
1964.....			.3	1.7	-	1.4	-

NA Not available.

¹Change from December 31 of prior year to December 31 of given year.Source: RIS, successive issues of *Survey of Current Business*. ARTS, Census Publications. Bias adjustment, Bureau of Economic Analysis.

Since 1973, the Census Bureau has been asking firms in its monthly inventory survey to supply sources of inventory statistics reported, according to the following four categories:

1. Physical or perpetual inventory records
2. Estimates based on other records
3. Estimates not based on records
4. Derived by use of purchase/sales formula

Number 4 reflects inventory estimates prepared by the respondent on a worksheet printed on the back of the form used by the Census Bureau in the RIS. (See appendix C.) Responses have yielded some puzzling results. For example, wide use of the purchase/sales formula is reported by large department stores chains; in the first half of 1975, inventories supposedly reported under this method accounted for one-seventh of all inventory data obtained from such outlets. However, for large department store chains the purchase/sales relationship is an aspect of the elaborate set of monthly records department stores maintain, typically in the retail method. Firms obtaining their monthly inventory values by the retail method should have checked category 1, "physical or perpetual inventory records." Telephone calls made to several large department stores that had checked category 4 revealed they were actually using the retail method monthly and not the purchase/sales formula.

Although there is some ambiguity concerning differences in usage among categories 1, 2 and 4, the combined sum of these

answers seems to represent use of some sort of inventory record or an estimate based on records. Category 3 is "estimates not based on records." Table 3.15 shows results of the four-category survey in the RIS for three time periods.

Using the latest survey results and combining Groups II and I with inventory weights of 1 and 2, respectively, yield an overall proportion of 26 percent for estimates of monthly inventories not based on records (category 3).²⁰

Census has investigated "no records" companies to see whether their reported inventories demonstrate a downward bias. Generally speaking, the results have been inconclusive; results for all kinds of business combined are different from those at the detailed KB level. Reports from companies showing identical values of inventories for both the current and prior month have also been examined but they constitute an extremely small proportion of all reports.

One hypothesis that could explain the tendency of retailers to understate their inventory change on a current monthly basis is use of historical gross margins. Consider, for example, a retailer who does not maintain a formal monthly inventory system, as described in chapter 2, but who does take stock for tax purposes some time after the close of a calendar or fiscal year. Assume this retailer keeps records on the firm's monthly sales and on invoices so monthly purchases can be determined.

²⁰Weights are derived from 1974 ARTS.

Table 3.15. SOURCE OF INVENTORY DATA REPORTED BY RETAILERS TO THE CENSUS BUREAU IN RETAIL INVENTORY SURVEY, GROUP II AND GROUP I RETAILERS

(Percent of total inventories in each group)

Period	Group II						Group I					
	1	2	4	Sum of 1,2,4	3	Total	1	2	4	Sum of 1,2,4	3	Total
December 1974-May 1975.....	51	21	10	82	18	100	40	23	7	70	30	100
March 1974-September 1974.....	52	18	11	81	19	100	36	22	11	69	31	100
July 1973-December 1973.....	51	26	11	87	14	100	39	26	10	75	26	100

Note: 1 = Physical or perpetual inventory records.
 2 = Estimates based on other records.
 3 = Estimates not based on records.
 4 = Designed by use of purchase/sales formula.

Source: Bureau of the Census unpublished data. Memorandum by Louis Shapiro to Michael Farrel, Business Division, Bureau of the Census, January 31, 1975 (1973-74 survey). Memorandum by Paul Brower to Irving J. True, Business Division, Bureau of the Census, September 3, 1975 (1974-75 survey).

If this retailer applies a correct cost-price ratio (the complement of the firm's gross margin) to sales, it should be possible to derive an approximation of the firm's inventories. This procedure, often labeled the gross profit approach, is illustrated on the back of the Census Bureau's monthly inventory form as an aid to respondents.

If the retailer is always using last year's gross margin, and if there is an upward trend in margins (the gross markup over costs) for which he or she fails to make allowance, this would result in a lower preliminary estimate of inventories than was actually the case. An example is given below:

Item	Preliminary	Final
Beginning inventory.....	100	100
Purchases.....	520	520
Sales.....	1,000	1,000
Ratio of cost of sales to sales		
Last year.....	.52	-
True ratio.....	-	.5
Sales at cost value.....	520	500
Ending inventory.....	100	120

The central point of this hypothesis is that a firm typically may use a gross margin that is too low or a cost-price ratio that is too high in estimating inventories during the year. A firm need not use a cost of goods sold ratio from last year's income tax; it could resort to a rough, constant margin like one-third or one-half as a modal margin for merchandise sold.

Retail gross margins have increased over the past 20 years. Table 3.16 illustrates this general upward movement in gross margins of department stores.

In 1974 the Census Bureau conducted an elaborate record-keeping survey of firms reporting in the monthly inventory survey in order to ascertain more about data being submitted. The Bureau asked, among other items, about sources of data reported in each of two adjacent months during 1974. Almost

60 percent of Group I firms indicated their answers were either estimated (49.9 percent) or "partly estimated, partly copied from records" (9.2 percent). The questions may have been unclear since all inventory accounting involves some estimation. But, the interest here is in a breakdown of procedures used by firms estimating or partly estimating their inventories. The table below provides the distribution for Group I firms.

Item	Percent of Firms
Purchases at cost, with previous year's margin applied.....	23.5
Net sales and purchases.....	4.6
Percent gross profit.....	2.1
Estimate purchase and sales.....	3.0
Purchase/sales formula.....	4.9
Subtotal.....	38.1
All other reasons.....	40.0
Question unanswered.....	21.8
Total.....	100.0

Source: Unpublished data from the Bureau of the Census.

These data should not be viewed as reflecting real differences in the first five categories. They suggest there is a large number of firms using techniques in which some kind of past margin plays a role. It is entirely possible for some firms to keep records either on a permanent or monthly basis and also to make use of historical gross margins in estimating their inventories.

Use of Surveys to Obtain Inventory Data

For many years within the Census Bureau, acquisition of monthly retail inventory data received much less attention than

Table 3.16. GROSS MARGINS OF DEPARTMENT STORES

Year	Percent of sales
1965.....	35.57
1966.....	35.77
1967.....	36.08
1968.....	36.24
1969.....	36.95
1970.....	37.48
1971.....	37.97
1972.....	38.33
1973.....	38.12
1974.....	38.41

Note: Results based on stores with annual sales of over \$1 million.

Source: National Retail Merchants Association, Financial Executives Division, Financial and Operating Results of Department and Specialty of 1974. Data taken from table 1.

retail sales data. This may have occurred because Census Bureau staff believed that many retailers, especially small ones, could not report accurate inventory values monthly. It was thought that including a request for inventory values with the monthly Current Retail Trade survey, would result in lower response rates for the sales survey, which has always been of major importance to the Census Bureau. The monthly inventory survey thus was assigned a relatively low priority and was conducted separately. Publication of the results was undertaken by the Bureau of Economic Analysis. However, in recent years Census has become much more concerned about these monthly data.

It clearly is harder to collect and process inventory data than sales data. The process of measuring quantities in stock and valuing those quantities often is complex. Recordkeeping is admittedly poor for very small firms. However, the Government is committed to estimating inventories and their change, and collection of inventory data should receive more attention.

Early in the course of this study, it was suggested that the Census Bureau attempt to collect data on inventories in the Current Retail Trade survey. The added question would be included in the retail sales survey in the same way that credit data are "piggyback." This would result in a great expansion in the number of firms reporting inventories. However, the Census Bureau expressed concern over possible adverse effects this could have on response rates of the monthly retail sales survey. Out of these discussions, a program was developed in 1976 to test empirically whether inclusion of the inventory question would lower response rates for sales data. There were 3 sample sets of approximately 800 cases each, randomly drawn from a panel of small (Group I) firms not then in the monthly surveys.

A. Control group: sales and credit data only collected (form A).

B. Sales, credit and inventory collected on the same form (form B).

C. Sales and credit collected on one form (form A) and inventory value collected on a separate form (form C) from the same firm. The purpose of the separate form was to permit respondents more time in reporting inventories.

The Census Bureau contacted each firm twice, once in late November 1976 requesting data for October and November 1976, and once in late January 1977 requesting data for December 1976 and January 1977. Closeout dates varied; they were 13 working days after mailout for panels A, B and part of C and 18 working days after mailout for that part of C receiving form C. These closeout dates were the same as those used in the regular monthly sales and inventory surveys.

There were some problems. The execution of this program was delayed for many months because the request for approval of the forms coincided with a mandate from the White House and the Office of Management and Budget to reduce the number of requests for information from the public. Also, in wholesale trade, where sales and inventory are collected on the same form, the nonresponse is about 10 percent for sales and about 20 percent for inventory. In other words, firms accounting for about 10 percent of the value of sales submit reports omitting values of inventory, a point which should be kept in mind in evaluating the test.

The results showed the response rate on sales was poorer when inventory questions were also asked, as the table below indicates. The figures are percentages of firms that provided sales data in each panel. Tests of significance by Census revealed that at the 2-sigma level differences were not significant in the October-November phase but were significant in the December-January phase.

Retail Trade Response Rate by Type of Questionnaire

(Percent)

Period	Group		
	Sales only (A)	Sales and inventory on same form (B)	Sales and inventory on different forms (C)
October-November collection.....	78	73	75
December-January collection.....	89	80	78

Source: Memorandum of April 27, 1977 by Harriet Pitts to Caesar Hill, Census Bureau, with adaptations by the National Bureau of Economic Research.

The A group, reporting sales and credit but no inventory data, had the best response rate. Actually, however, the collection rate is surprisingly high under all circumstances considering that the sample was confined to small (Group I) retailers.

RECOMMENDATIONS

Monthly Inventories

1. The Bureau of the Census should take full responsibility for preparation and publication of monthly retail inventory statistics. Plans are currently under way to accomplish this objective.

2. Census Bureau tests on collecting inventory, sale and credit data monthly on the same form conducted in the fall and winter of 1976-77 were useful. The importance of the monthly retail sales data, which are directly utilized to estimate almost one-fourth of GNP each quarter, cannot be ignored; because this is a matter of major importance one further test is suggested. The panel that received the "sales only" form should be sent the "sales plus inventory" form, and the other panel should receive the "inventory only" form.

Even though including questions on inventory depresses response rates for sales, adding questions on inventories to the existing sales survey should still be considered for the following reasons: First, the sales response was very high for the small firms covered by the test. Further, the large (Group II) firms probably would have no problem in reporting sales and inventory in the same survey. By concentrating only upon Group I in the test program the lower response rate was probably exaggerated.

Second, if inventory questions were not incorporated as elements in the same survey with sales a substantial increase in sample size of a separate inventory survey would be required. Thus, it may be optimal from a cost point of view to add inventory questions to the sales survey. The sales response rate may drop a few points, as indicated by the test, but the broad view, in which cost and quality are balanced, must be considered. Combining inventory with the existing sales survey would add little to the cost of that survey.

If the monthly inventory survey is continued as an independent sample, the sample size should be greatly enlarged, and birth supplementation should be included. Preliminary and final estimates should be obtained for each month in successive surveys.

3. Some consideration should be given to removing the monthly data on accounts receivable from the Current Retail Trade Survey and confining this question to a small, separate survey conducted annually. A small proportion of respondents in the retail sales survey make sales for which retailers become creditors; for most respondents the inquiry is irrelevant. The Federal Reserve Board is the major user of these data, but uses them only retrospectively and not on a current basis.

4. As in the case of wholesale trade surveys, responsibility for collecting reports from LIFO firms and very large firms should be shifted from field offices to Washington, D.C. Special care must be taken to insure that large firms report data for their entire operations.

5. The Census Bureau should increase its investigation of sources of bias in monthly data. In this regard, changing the monthly inventory form would be helpful: Questions should be phrased so Census Bureau staff can distinguish among those estimates that are part of a formal accounting system or tied closely to such a system, those based on purchase/sales formulas, and those based on neither. In connection with the second category, it would be worthwhile to ask the vintage of the gross margin used in reducing sales to cost value (last year's, average of recent years, a fixed figure used every month, etc.).

6. In some respects the inventory detail being collected today is less than that regularly collected many years ago. For example, in the past the Federal Reserve obtained statistics by departments within department stores. Data by department on sales and inventories (and on orders placed as recommended in chapter 14) should be collected for department stores. Such data would be useful adjuncts to information now used for analyzing consumer demand developments. A similar approach might be considered for variety stores and franchised automobile dealers. In the latter case, the goal is to segregate sales and inventory of new cars, used cars and trucks, and parts sales and service receipts.

The Annual Survey

7. The quality of data being reported in the ARTS should be assessed more carefully. Since information on sales, purchases and inventories is requested in the survey, it should be possible to calculate an approximate gross margin. When the gross margin of a respondent shows large differences from one year to the next—which has been observed in special Census Bureau tabulations of data from individual respondents—the respondent's entire ARTS reply should be set aside for followup. The subsequent investigation should determine whether the large change in margin is real or whether the reported sales, purchases or inventories figures are incorrect.

8. An attempt should be made to obtain December 31 inventories for the ARTS in view of the large proportion of firms now supplying fiscal year data. Firms could be asked to furnish revised December 31 figures in light of the fiscal year ending figures. Census already has begun a review of this problem.